TERMS OF REFERENCE FOR MACHINE TRANSLATION (MT) STUDY WORKING GROUP

OBJECTIVE: The purpose of the MT Study Working Group will be to determine the current state of development of machine translation and its usefulness to the intelligence process. If the study concludes that automated translation systems are efficient and economical, resource requirements for a five year program should be proposed and justified.

SCOPE: The Working Group will consider Service/Agency translation requirements, available automated translation aids and systems, and alternatives based on projected technological development. Emphasis should be placed on Russian-English translation requirements and MT methodologies and should not be limited to scientific and technical applications.

TASKS: The Working Group will:

a. Refine and supplement data with regard to Service/Agency translation requirements and costs. Use DIA MT survey as baseline.

b. Survey and evaluate MT state-of-the-art. Refine and supplement data provided by USAF SAB, FTD and FBIS MT conferences, vendors and users.

c. Determine costs, effectiveness, and utility of MT. Alternative automated techniques to support the translation process should be evaluated and resource requirements/tradeoffs identified.

d. Provide findings and recommendations.

ORGANIZATION: The Working Group will consist of action officers from Army, Navy, Air Force, DIA and NSA; Air Force will provide the chairman. CIA is invited to participate. Action officers will coordinate the accomplishment of appropriate Working Group tasks within their respective Service/Agency.

SCHEDULE/REPORTS: Three to four working group meetings are anticipated between 22 March and 23 April. Draft report should be provided to the MT Steering Group by 23 April. Final report is due to ASD(I) by 1 May 1976.

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STATE ACTIVITIES

REPORT OF THE AD HOC WORKING GROUP ON MACHINE TRANSLATION

PROBLEM: Assess the effectiveness and utility of machine translation for the intelligence process.

EXPLANATION OF TERMS:

- Human Translation (HT): The process by which a human transfers the meaning from the linguistic pattern of a source language to the linguistic pattern of an object language.

- Machine-Aided Translation (MAT): A computer-based system for the storage and retrieval of lexical information, designed to assist and improve the proficiency of the human translator.

- Machine Translation (MT): A computer process which accomplishes the translation function without human assistance except, as required for quality improvement, in a post-edit function. Current MT systems have lexical, syntactical, and semantic components which produce translations of a given level of quality. Based on the amount of human post-editing required to achieve a level of quality acceptable for publication as a finished product, MT systems can be characterized as second or third generation systems. Second generation systems require 25-30% post-editing whereas a third generation system would require 5-10% post-editing. Increased sophistication of lexical, syntactical, and semantic components and the addition of techniques to accommodate contextual and pragmatic information are required in a third generation system to resolve problems of style and ambiguity in journalistic/literary prose. Finally, the automation of input to the MT process must be included in the context of an MT system.

- Scientific and Technical (S&T) Prose. A style of writing largely constrained and regularized by a need to present a logically coherent discourse. It is, therefore, amenable to the logical formulations required by second generation MT systems.

- Journalistic/Literary Prose. A style of writing that lacks precision and conciseness and is largely unconstrained and informal. It is characterized by colloquialisms, idioms, proverbial expressions, metaphor, and other literary devices. Syntactic complexity is exemplified by structural inversions, ellipsis, and grammatically incomplete utterances. A third generation MT system must be able to solve fundamental linguistic problems which obscure meaning and comprehension to provide a quality translation of journalistic/literary materials.

FACTORS BEARING ON THE PROBLEM:

FACTS:

1 - Exploitation of foreign language materials can provide valuable intelligence regarding capabilities and intentions.

3 - Principal emphasis is on the translation of Russian into English.

8 - Current MT systems have proven useful and cost/effective for translation of S&T materials.

7 8 - Automated techniques can improve the ~~effectiveness~~ quality & efficiency of the human translation process. In what way?

2 - Indicative translations and keyword applications have a utility in the intelligence process.

9 8 - Current state-of-the-art of MT cannot produce high quality journalistic/literary output without significant post-editing.

10 9 - Current input techniques are a major constraint to cost/effectiveness and timely MT production. Would MAT be helped by improved input systems.

11 10 - Current MT systems are based on a technological base that is now 20 years old.

4 - ~~There is~~ A substantial volume of ~~Russian~~ substantive intelligence material in Russian ~~which~~ remains untranslated.

5 Not relevant - The quality of human translation varies considerably and human translator proficiency must be improved. Relate to MAT & MT.

6 Availability of linguists - Manpower and fiscal constraints preclude a substantial increase in human translator resources in the Department of Defense.

ASSUMPTIONS:

- ~~There has been considerable development~~ Advances in computer technology and linguistics ~~such that~~ makes possible a new synthesis ~~is possible~~ which could produce improved translations on a more cost/effective basis.

- Continued enhancement of currently operational MT systems will reach a point of diminishing returns; the third generation MT system requires an advanced technological approach.

- Machine-aided translation techniques and advanced Optical Character Reader (OCR) technology afford the greatest potential ~~for~~ in the near term. for what

- Development of a third generation MT system is a long-term evolutionary process best pursued by small scale support of a variety of technological approaches.

CRITERIA:

- An MT system must have utility to the intelligence process by:

  - Providing more timely, higher quality translations

  - Offsetting a lack of human translation expertise # resources

  - Being competitive with other translation methods such as

  - Being responsive to the needs of the consumer with regard to completeness and quality.

BACKGROUND:

1. Efforts to apply automated data processing (ADP) techniques to the problem of language translation have been under way for over 20 years. The Air Force Systems Command's Foreign Technology Division (FTD) has developed a large-scale MT system ~~which provides~~ that provides translations of Russian language scientific and technical literature which satisfies the needs of FTD's analysts. Other initiatives have been undertaken in the Intelligence Community which address dictionary development and keyword selection. All such efforts are aimed at improving the capability to exploit foreign language materials for intelligence purposes and provide a more responsive method for exchange of data with other nations. what is meaning of last phrase

2. The requirement to translate [a volume of] contemporary Soviet military and socio-political materials has generated renewed interest in MT. As a result of initiatives by the Deputy Assistant Secretary of Defense (Resources and Management) and by the Assistant Chief of Staff, Intelligence, USAF, the Defense Intelligence Agency (DIA) conducted a preliminary survey of community translation requirements and needs for MAT and MT. The results of this survey was provided to the Air Force by DIA letter, subject: "Survey of Machine Translation Requirements," 23 Jan 1976. In addition, the Foreign Broadcast Information Service sponsored a seminar on machine translation, 8-9 March 1976. This seminar was attended by a wide variety of experts from government, ~~commercial vendors~~, industry and the academic community and provided a valuable forum for the exchange of information concerning the current state-of-the-art and potential of MAT and MT.

3. In the Intelligence Annex to the FY 78-82 Planning and Programming Guidance Memorandum (PPGM), 13 Feb 1976, the Deputy Secretary of Defense tasked the Air Force to: "chair studies which will determine current state of development of machine translation and its usefulness in the intelligence process." The PPGM further tasked the Army, Navy, NSA and DIA to participate in this effort and invited CIA to send representation. If this study determined that automated translation systems are efficient and economical, such findings together with proposed resource levels for a five year program should be furnished in a report to the Assistant Secretary of Defense (Intelligence).

4. In order to accomplish the PPGM tasking, on 19 March 1976 the Air Force convened a meeting of senior representatives from the Services and Agencies concerned to develop terms of reference for the study. A series of working group meetings were held in March and April to evaluate the state-of-the-art, refine Service/Agency requirements, and develop a program for MAT/MT. The DIA MT Survey and the data acquired through the FBIS Seminar provided valuable material for consideration by the MT Study Group. This report sets forth the findings and proposals of the Study Group.

CURRENT SITUATIONS:

1. FTD is the only DOD organization currently employing a large-scale MT system. The system is used successfully for translation of S&T materials. Output is provided in an unedited, partially edited, or fully edited version, depending on the requirements of the consumer. The system can provide indicative translations of journalistic/literary material but has never been optimized for such prose. FTD is also pursuing initiatives to improve the efficiency of the input and post-edit processes.

2. Other agencies employ human translation and rely principally on the Joint Publications Research Service (JPRS) and commercial vendors. The quality of ~~such~~ some (much) translation support ~~varies such~~ is so inferior that considerable additional editing is often required before publication of the finished product.

a. Two major translation efforts are conducted by the Air Staff (Directorate of Threat Applications). They are: Monthly Soviet Press Translations and the Soviet Military Thought series, generally published in book form. These projects require translations to be in high quality, idiomatic English. The Soviet Military Thought series is an open-ended project, and each book averages 75,000 words in length. The current average montly volume of Soviet press translations is 13,000 words. The Air Staff has identified requirements for translation of 13 additional Soviet journals and newspapers, totalling 14,000 pages annually.

b. At the Army Staff level, MT has not been seriously considered for meeting translation needs. Approximately 80% of the Army translation effort involves S&T materials for the Foreign Scientific and Technical Center (FSTC). Those Army Staff needs are met by outside contract, some in-house capability, and potential in the interrogator trained personnel at Fort Bragg and Fort Hood. A Reserve Officer translator program also exists. Approximately 2.9 million words per year are currently translated. Army estimates that 7.5 million words per year would be translated if additional resources were available for such tasks.

c. Approximately one million words per year of carefully screened Soviet Naval literature are translated by the Naval Intelligence Support Center (NISC). Additionally, approximately one half million words per year of Soviet Naval literature are translated using contract services. In the area of Soviet socio-political literature, Navy requirements are almost completely satisfied by the document exploitation service offered by FBIS. The Navy also has a Naval Reserve Officer translator program. However, there is still a considerable amount of military/technical literature that remains untranslated, resulting in a significant loss to intelligence production. The Navy estimates that an additional two million words per year would be translated for intelligence exploitation if additional resources were available. NISC maintains that a translation must be as near perfect as possible. Consequently, an MT system that would satisfy NISC requirements must produce translations subject to the same quality grading that applies to its human translators. Current Navy initiatives are directed toward development of lexical aids.

d. DIA supports the MT efforts at FTD within the general area of the DOD Scientific and Technical Intelligence Information Support Program (STIISP). In addition, DIA is presently translating, or having translated for it, a total of approximately one million words per year. If additional translation capability were developed, DIA estimates that this requirement would increase to 1.9 million words per year.

e. FBIS currently produces 235,000 pages (100 million words) annually. Sixty languages are involved, with Russian accounting for 45% of the total workload. Approximately one-third of the total effort involves S&T material; the remaining two-thirds involve political, military, economic, biographic, and sociological material. FBIS draws on a roster of about 750 translators and relies on JPRS to a considerable degree. All translations must be of literary quality. FBIS maintains that adequate human resources are available to satisfy its requirements. MAT techniques can materially improve the quality and efficiency of human translation and initiatives are being pursued in the development of lexical aids. FBIS constantly reviews developments in the field of MT to assure that cost-effective programs are implemented. However, FBIS is not interested in funding MT development efforts at this time.

Suggested replacement of paragraph f, page 9

f. NSA is extremely interested in the processing of natural-language material in both graphemic and phonemic form. Not all this material need be translated. However, what must be translated into English must eventually pass through several layers of quality control. The final output of the translation process, in addition to appearing with due timeliness, must maintain the semantics of the original material: it must omit nothing of significance, it must add nothing of significance and, to the greatest extent possible, it must minimize the distortion unavoidably resulting from conversion of semantics of the source language to semantics of the target language. Currently, NSA is continuing its development of computerized lexical aids, dictionaries, and keyword search techniques. Recognizing the similarity of some of their needs in these areas of MAT, the NSA and CIA contingents to the MT Working Group have agreed to coordinate their MAT efforts.

f. NSA is interested in MT, particularly in its application to Russian language texts. However, the nature of NSA's translation problem has unique aspects which may require development initiatives ~~which differ~~ differing from those undertaken in support of general intelligence community requirements. Currently, NSA is in the process of developing computerized lexical aids, dictionaries, and keyword search techniques. As a result of MT Working Group activity, NSA and CIA have agreed to coordinate such efforts which address their mutual translation requirements.

g. The Intelligence Community Staff is concerned with the overall problem of linguistic expertise in the United States. This problem results from the relative lack of emphasis on foreign language training in the American academic environment and inadequate professional opportunities and rewards for linguists. The IC Staff supports initiatives in MAT ~~which can~~ to improve the professionalism of linguists and intelligence analysts and in MT ~~which may assist in~~ to providing responsive translations of pertinent material for intelligence exploitation.

DISCUSSION:

1. Information provided by the DIA MT Survey indicates that there is a definite requirement for additional translation of Soviet material, principally in the journalistic/literary category of contemporary Soviet military doctrine, concepts and related subjects. It is not possible to determine how much of this additional requirement is duplicative, but the shortfall ranges from a minimum of 5 million word annually to a cumulative total of 12 million words. The actual requirement, therefore, is between these extremes and is, in any case, substantial. In addition, the amount of such material is constantly expanding. (Recast last sentence.)

2. The FTD experience is useful in determining the cost-effectiveness and utility of MT for high volume translation. At the request of the Assistant Secretary of the Air Force, Research and Development, the USAF Scientific Advisory Board (SAB) conducted a study of the FTD Translation System. The SAB reported (5 June 1975) that the output was highly acceptable to FTD analysts, ~~and that~~ the system was ~~almost~~ competitive in cost with human translation. The SAB noted that 75% of the MT cost was accounted for by post-editing and recomposition to provide material that is camera-ready for the printer. Automation of these processes, as planned by FTD, would lower the cost of finished MT product below that of human translation. Subsequent system improvements have enabled FTD to ~~provide~~ analysts with a greater proportion of unedited or partially edited MT output ~~which satisfies user requirements~~.

a. The following figures represent FTD's translation production, in pages of Russian material (each page averages 250 words), for the period July 1975 through March 1976.

Unedited MT	20,991
Partially Edited MT	14,143
Finished MT	951
Manual	5,013
Total	41,098

b. The following figures represent approximate direct labor and materials cost per 1,000 words translated at FTD.

Unedited MT	$ 8.63
Partially Edited MT	17.87
Finished MT	32.38
Manual Draft	27.28
Manual Finished	36.00

34. The Air Staff has conducted experiments using the FTD MT System for translation of purely journalistic/literary material. The output provided was indicative of content but would require excessive post-editing to obtain a literary English language product. The system's limitations in this area are accented because optimization efforts have never been directed toward a journalistic/literary capability. In this regard, a major effort to achieve a literary output by optimizing any currently operational system is not advisable. Such systems are implemented on a conceptual and technological base that is 20 years old. As stated by several participants and commentators at the FBIS MT Seminar, a fundamentally new approach is required to resolve the problems which have precluded current MT systems from providing a high quality output with minimal post-editing.

45. MT Working Group participants have expressed the requirements of their respective agencies for high quality literary translations. Admittedly, material of long term value intended for wide distribution should be published as a quality product. However, considerations involving the American-Soviet Copyright Agreement of May 1973 may well require the restriction of a large volume of material for internal government use only. In addition, there is a considerable amount of material of a transient nature which is required by intelligence analysts but need not be provided in a high quality or camera-ready form. The major constraint in using state-of-the-art MT systems for such timely indicative translations is the requirement for manual input of the material to be translated. It is currently more practical to have human translators scan material for content and value to intelligence analysis. Inasmuch as translation resources are limited within the Department of Defense and a volume of material with potential intelligence payoff goes untranslated, automation of the MT input process is a priority requirement. The development of an OCR system would bring the computer power of an MT system to bear on the problem in a cost-effective and responsive manner. Such a development effort is required to improve the performance of the present FTD system as well as for ~~my~~ any third generation system which may evolve. Although the material presented at the FBIS MT Seminar on OCR technology was not encouraging, other opinions obtained from Seminar commentators indicated that such technology is approaching a stage where it can be successfully employed in an MT process.

58. A program to attain high volume, timely production of journalistic/literary Russian translations should have the overall aim of delivering the highest quality translation necessary and sufficient to satisfy the user's information requirements at the lowest cost. High quality translations have been the goal in the past without regard to whether such quality is in fact required in all cases for the user to perform his task. The user presumably is the expert in the discipline of the document and does contribute something to the interface between himself and the translation in comprehending the material. The validity of this concept is demonstrated by the fact that users at FTD and Oak Ridge National Laboratories use the raw output of their respective MT systems.

~~output product~~

MT product

6. It is agreed that no MT system will totally replace the human translator. The goal in developing a third-generation MT system is to provide an output in idiomatic English that is faithful to the source input in content and meaning, with a minimum of human editing (5-10%). Such a system should provide the option for human intervention during the translation process as well as in a post-edit mode. The system should be modular and designed for ease of software maintenance. Finally, it should be as language-independent as possible to facilitate implementation of MT for languages other than Russian. Such a system would accommodate the requirement for timely translation of an increasing volume of pertinent material. By minimizing manpower-intensive input and editing functions, it would provide quality translations at a cost somewhere between that for unedited and partially edited MT at FTD.

7. There are numerous efforts underway which could lead to a third-generation MT system. Because ~~of the unlikelihood of~~ immediate substantial payoff from investment in this technology is unlikely and ~~uncertainty as to~~ the exact direction MT development should take is uncertain, a cautious and evolutionary approach is required. However, DOD involvement in such technological development is essential to insure that ~~it is responsive to~~ identified requirements are served. In this regard, near-term emphasis should be placed on MAT techniques, which offer more immediate practical benefits and which can make a valuable contribution (e.g., through dictionary development) to the emergence of any future MT system.

8. The MT Working Group participants agree that such initiatives in MAT methodologies should be pursued. Specifically, the emphasis should be placed on the continued development of dictionaries and lexical aids. Standard MAT software should be developed which would provide a common format for dictionary entries, provide on-line and batch processing capabilities for dictionary update and retrieval, and aids for editing and formatting of translations. Much of the dictionary development envisioned by Army and Navy will also contribute to improving the capability of the FTD system. The development of such MAT capabilities are well within the current state-of-the-art and will contribute substantially toward increasing the productivity of human translators. The consensus of the participants at the FBIS MT Seminar was that MAT techniques could provide an increase in productivity by a factor of 2-1 or 3-1. It appears, however, that an increase of 60% is a more realistic assessment. In any event, the benefits are substantial.

9. ~~Automated Data Processing~~ Technological development and implementation has often been characterized by multiple independent efforts which result in duplicative capabilities and unnecessary costs. To avoid this situation in proposed MAT and MT development efforts, a formal coordinating structure should be established at the USIB level. In the interim, if so directed by OASD(I), the MT Working Group can perform this function for the DOD.

In view of the difficulty in identifying the most lucrative approach to a follow-on MT capability, some mechansim for providing professional advice on MT development should be established. Considerable expertise is available at RADC. In addition, a carefully selected advisory body composed of a linguist, a computationist, a psychologist, an artifical intelligencer and a computational linguist would be helpful. Recognizing the biases that exist in all of these disciplines, the advisory nature of such a body must be emphasized.

human factors expert

Based on experience in developing machine translation systems, The Air Force is a logical choice for selection as Executive Agent for MAT and MT implementation.

CONCLUSIONS:

- MT has proven cost-effective and responsive to S&T user requirements.

- The current state-of-the-art of MT will not support quality production of journalistic/literary material without excessive post-editing. Lack of automated input technology precludes its effective use for indicative translations.

- A long-term, cautious and evolutionary development effort can provide a cost-effective system capable of providing timely, quality translations of an expanding volume of materials, a considerable portion of which is currently untranslated and unexploited.

- Immediate benefits can be obtained from implementation of MAT methodologies which would also contribute to development of an advanced MT capability.

- In the intelligence process, translations are useful insofar as the material translated contributes to the analysis of foreign capabilities and intentions. In this regard, considerations of quality must be weighed against requirements for comprehensiveness and timeliness.

RECOMMENDATIONS:

- That ASD(I) provide the following funding for implementation of near-term MAT and long-term OCR and journalistic/literary MT capabilities ($ in thousands):

	FY 77	FY 78	FY 79	FY 80	FY 81	FY 82
O&M	350	350	100	100	100	300
R&D	-	250	500	500	300	100

- That ASD(I) establish a formal coordinating group within DOD for MAT/MT and designate the Air Force as Executive Agent for MAT/MT implementation.

- That a similar structure be established by the USIB to address and coordinate overall community translations requirements, including both the improvement of translator professionalism and the implementation of automated aids for translation.

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4	INITIALS	SEE ME
	DATE	SIGNATURE

ACTION

REMARKS

Attached is rough draft ("partially edited") of MT final report; in Standard Staff Study format. I will set up a meeting next week, probably Tuesday or Wednesday, at Lynn Bldg. I should have this draft retyped on tape machine by then to facilitate incorporating your revisions. ASD(I) has given us a one week extension of the 1 May suspense.

STAT [redacted]

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